Office of the Washington State Climatologist

August 5, 2014

July Event Summary

In this Issue

Average July temperatures were warmer than normal statewide, and total July precipitation varied depending on location. In general, precipitation was much below normal in eastern WA and on the Olympic Peninsula, while a few wet days helped monthly precipitation reach normal to above normal totals elsewhere in the state.

The warm July temperatures persisted for nearly the entire month, and the mean monthly temperatures rank among the top 5 warmest Julys on record for stations around the state (Table 1). But the daily maximum temperatures for July are interesting as well, and there were many daily high temperature records broken around the state that will not be listed here. At SeaTac Airport, there were 12 consecutive days with high

Station	Mean July Temperature (°F)	Rank	Record Year/ Temperature (°F)	Year Records Began
Wenatchee	80.6	1st	-	1959
Omak	78.2	1st (tie)	-	1909
Yakima	77.8	1st	-	1946
Pasco	78.8	2nd	1945; 78.9	1945
Spokane AP	75.7	2nd	1906; 75.9	1881
Pullman	71.2	2nd	1998; 72.0	1940
SeaTac	69.2	2nd	2009; 69.5	1948
Bellingham	65.4	4th (tie)	1958; 68.0	1949
Olympia	66.7	5th	1958; 69.1	1948

Table 1: A sampling of WA stations with an average July 2014 mean temperature that ranks among the top 5 warmest since records began.

temperatures 80°F or higher, which ties as the second-longest streak of consecutive days at 80°F regardless of month. The longest stretch was 15 days in July/August of 1977. The number of days above 80°F was unusual, even if the days were not consecutive. For example, SeaTac Airport and Olympia had 19 and 18 days during the month with high temperatures at least 80°F, which rank as the 2nd and 7th most in July, respectively. For three eastern WA sites, we used 90°F as the threshold and found that Spokane (18 days), Wenatchee (23 days), and Omak (24 days) ranked 3rd, 3rd, and 5th, respectively. A threshold of 95°F was used for Kennewick and the 21 days this July was tied as the second-highest amount in the last 100 years of record. For most of these stations, July 1985 was the record-holder for the highest number of days above each threshold. So while the high maximum temperatures during July were unusual, they were not exceptional.

A deviation from the warm and sunny weather that persisted throughout July was the heavy rain that fell on July 23. An upper level low impacted the area from July 22-24, bringing considerable moisture and cooler temperatures. Many daily rainfall records were broken, for example, at the Seattle Weather Forecasting Office (0.89"), SeaTac Airport (0.76"), Bellingham (0.72"), Hoquiam (0.63"), Vancouver (0.52") and Olympia (0.27"), among others. Aside from breaking a daily record, the July 23 precipitation at SeaTac AP also ranks as the 4th wettest July day since records began there. Figure 1 shows the 24-hour precipitation totals ending on the morning of July 24 for WA State. This wet and cool period was beneficial for fighting the fires burning in eastern WA. Several fires had started due to lightning on July 14, including the Carlton Complex fire in north central WA (7 miles north of Twisp) that burned over 250,000 acres and is now the largest recorded fire in state history (overtaking the 1902 fire near Yacolt). Unfortunately, over 300 single residences and over 100 other structures were destroyed, and the fire is not yet fully contained. Fires were a challenge for the entire month, and it appears they will continue to impact the state for the rest of the summer.

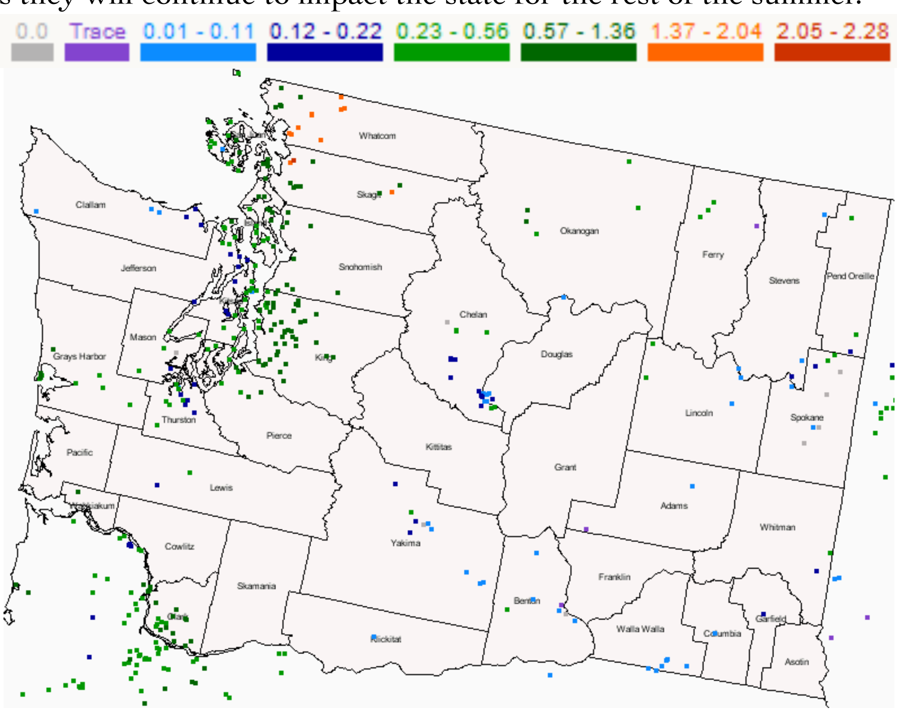


Figure 1: 24-hour CoCoRaHS measurements (inches) ending on the morning of 24 July 2014.

Drought Update

There have been some minor changes to the US Drought Monitor (Figure 2) since the last edition of the newsletter. The dry July conditions have certainly not alleviated the drought, and the wildfires have made the situation much worse. The Drought Monitor reflects only hydroclimate variables, and a lack of rain during this typically dry time of year usually has little effect on DM designations. That being said, in the last month the area considered "abnormally dry" (D0) has been expanded to encompass most of eastern WA to reflect the short term dry conditions. Increases in the severity of the depiction of drought in WA are being considered. The wildfires have been devastating for the communities affected, and have also had direct effects on some farmers in the state. The USDA Crop Bulletin reports that about 700 cattle have been killed, farms and orchards have been destroyed by fire, and generators are being used for irrigation pumps due to power loss. There are 8 large, active fires burning at the time of this writing.

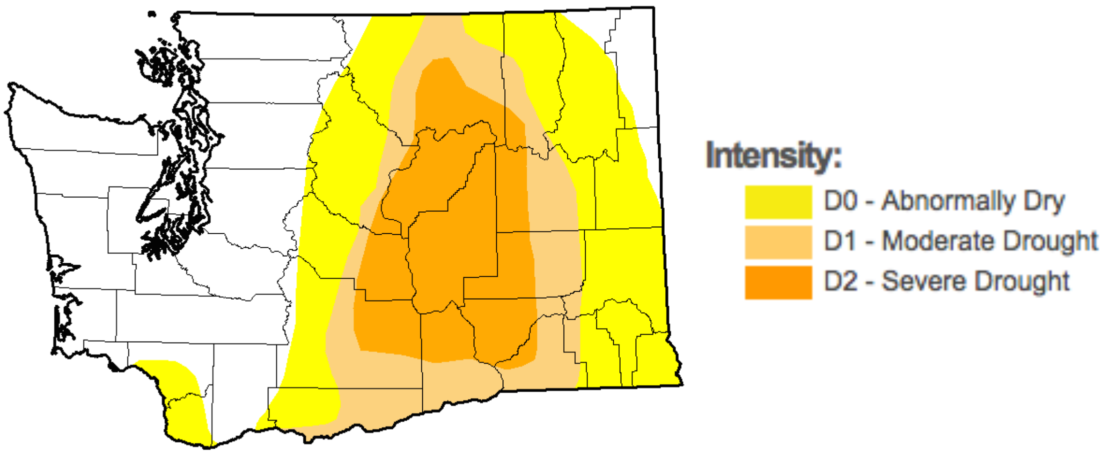


Figure 2: The 29 July 2014 edition of the US Drought Monitor (from the National Drought Mitigation Center).

Skill in ENSO Model Prediction

A message from the State Climatologist

We have previously discussed the skill of seasonal weather predictions for winter in this newsletter (March 2014 edition). One of the most important sources of information for these seasonal forecasts is the future state of El Niño-Southern Oscillation (ENSO). An ENSO warm event (El Niño) seems likely for the upcoming winter, as indicated in the set of predictions from modeling centers around the world shown in Figure 3. This El Niño is taking its sweet time in development, and so how much should we trust these kinds of predictions?

Considerable effort has gone into assessing the skill of present-generation ENSO models. A recent review of the topic is provided by Barnston et al. (2012); some excerpts from that paper are reproduced below. Once formed, the maintenance of an El Niño or La Niña event is reasonably well understood. Air-sea interactions in the tropical Pacific are crucial, with mutual reinforcement between the atmospheric and oceanic anomalies. On the other hand, we have much less understanding of the mechanism(s) that kick ENSO from one state into another. This is reflected in the diversity in the statistical models for ENSO prediction, which key on different variables in the atmosphere-ocean system. The dynamical models are more alike in principle, but nevertheless generally yield a range of forecast trajectories, as in the example shown in Figure 3.

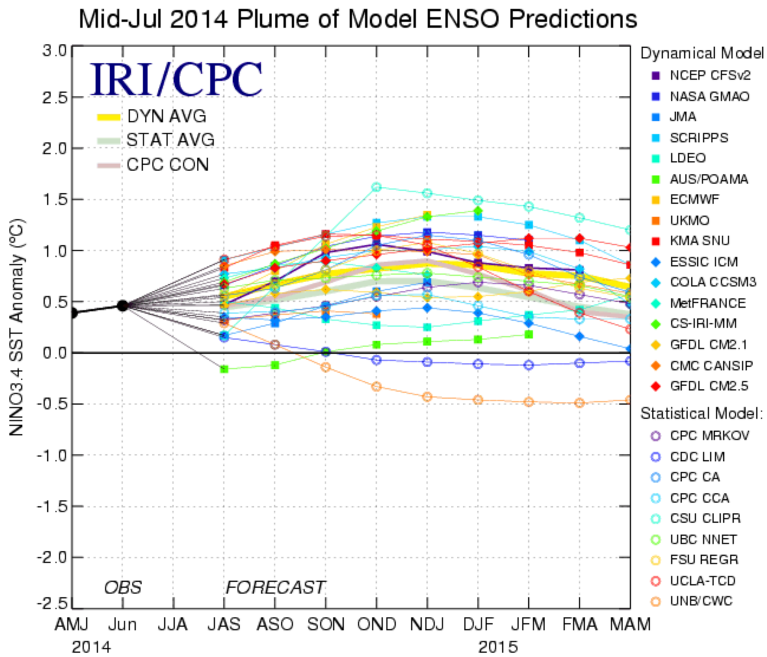


Figure 3: Time series of sea-surface temperature anomalies in the Niño3.4 region from a variety of statistical and dynamical prediction models as of mid-July 2014. [From IRI/CPC]

There are various ways to quantify forecast skill. One measure commonly used is the root mean square error (RMSE), which relates to the average magnitude of the deviation between the values predicted by a model relative to observed values. The average RMSE as a function of lead time for a variety of ENSO models is shown in Figure 4 (from Barnston et al. 2012). These results are for the period of 2002 through 2011, and there will be more about this later. The lower the RMSE the better, and values up to about 1 indicate useful skill. This threshold is reached on average at ~6 months for most of the models tested. There is a marked seasonal dependence in the performance of these models, with forecasts initiated in the northern hemisphere summer (winter) tending to be more (less) skillful, especially for lead times exceeding a couple of months.

The predictability of ENSO also varies on multi-year time scales. As shown in Figure 5 (also lifted from Barnston et al. 2012), 2002-2011 was a period of relatively low predictability, with smaller correlations between model ENSO predictions and observations than during much of the period of model validation. This relates to the weak amplitude of ENSO during that same period (lower panel of Fig. 5). Since predictability was low in 2002-2011, perhaps the results shown in Figure 4 reflect the lower limits on model skill.

The consensus of the models is that there will be an ENSO during the upcoming winter that will be strong enough to impact the global-scale atmospheric circulation. Of course, we do not know how it will play out exactly in terms of the weather of our region, but we'll be watching.

Reference

Barnston, A.G., M.K. Tippett, M.L. L'Heureux, S. Li, and D. G. DeWitt, 2012: Skill of real-time seasonal ENSO model predictions during 2002-11 - Is our capability increasing? *Bull. Amer. Meteor. Soc.*, **93**, 631-651.

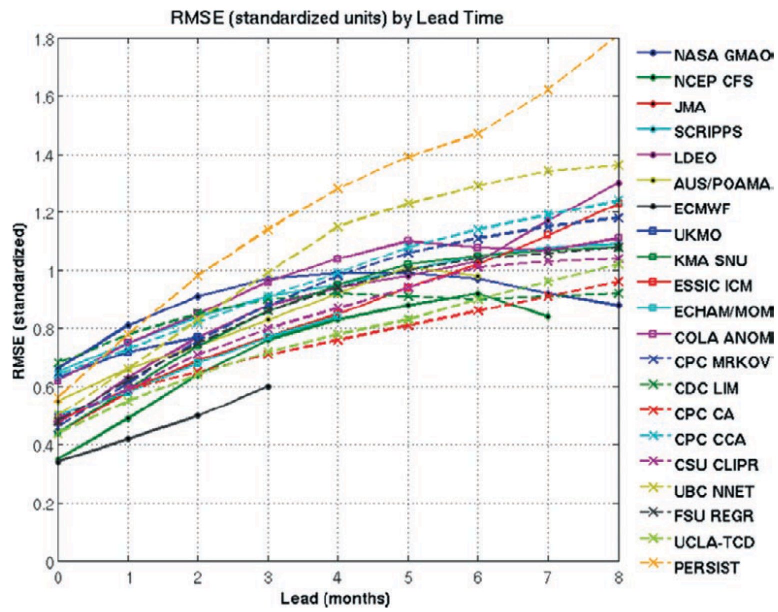


Figure 4: The standardized root mean square error (RMSE) for 20 models as a function of lead time (in months) over the 2002-2011 period. [From Barnston et al. 2012]

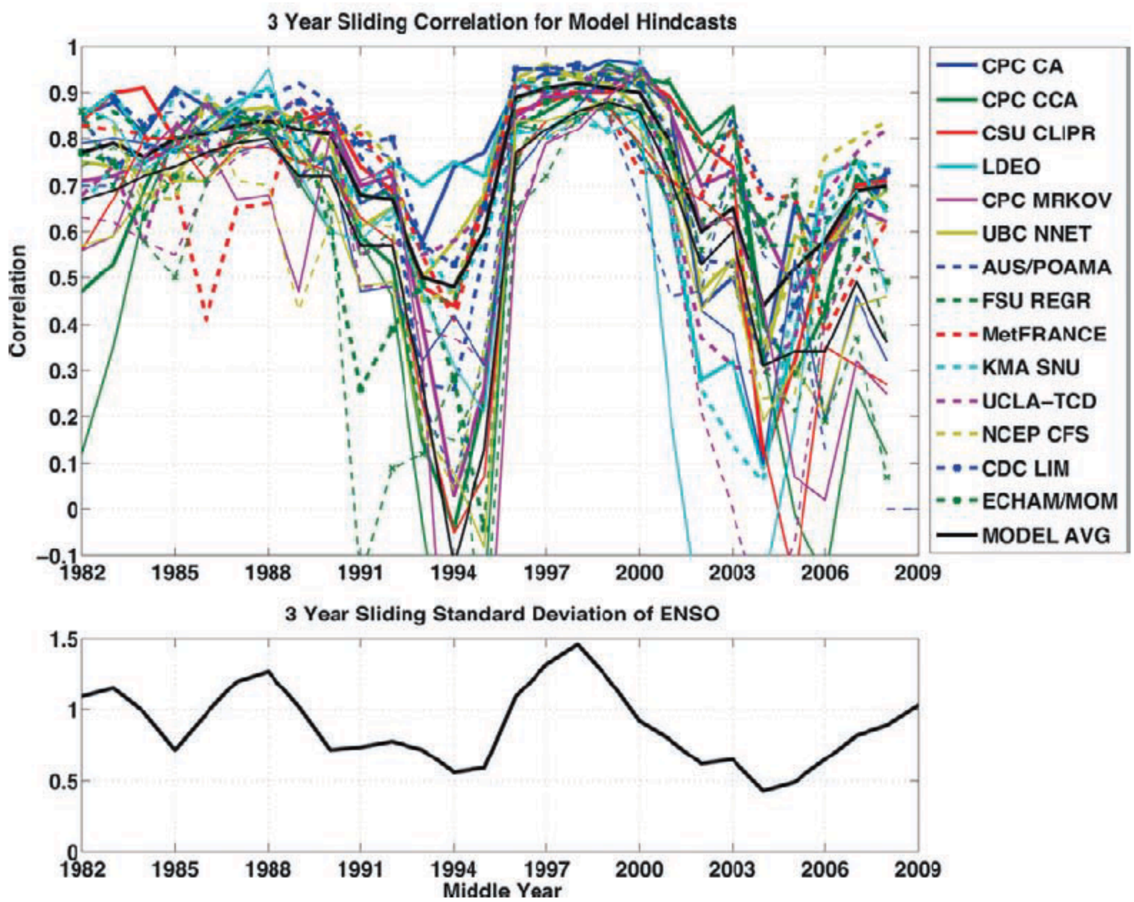
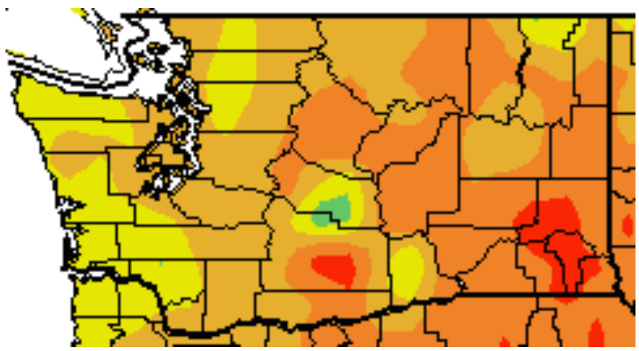


Figure 5: A time series of correlation between model predictions and observations with a 3-year moving average for 14 models (top). The thick lines represent the correlations for 3-month lead times; the thin lines are for 6-month forecasts. The black lines represent multi-model averages. The standard deviation of the sea-surface temperature anomalies for the same sliding 3-year periods is shown in the bottom panel. [From Barnston et al. 2012]

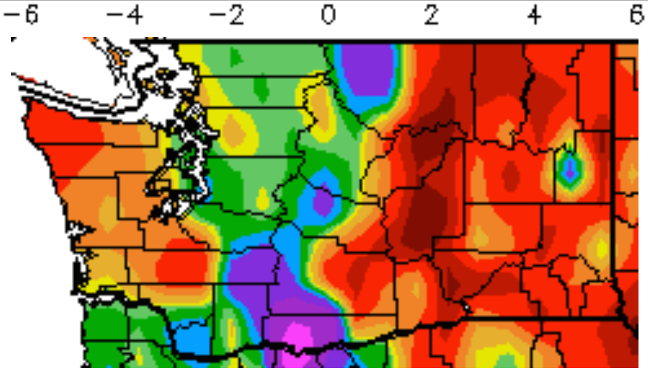
Climate Summary

Mean July temperatures were warmer than normal across the entire state. The largest warm anomalies are in the southeastern part of WA where mean July temperatures ranged between 4 and 8°F above normal. Wenatchee was a particularly warm spot, with temperatures 6.4°F above normal, and temperatures throughout the eastern WA towns and cities listed in Table 2 were at least 5°F above normal. The warm anomalies west of the Cascade Mountains were not quite as large, with most mean monthly temperatures between 1 and 4°F above normal.

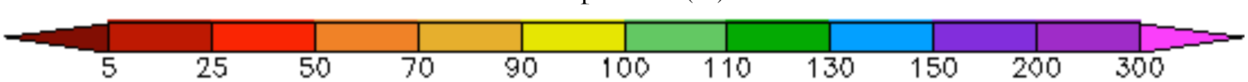
Total July precipitation was much below normal throughout eastern WA, with some locations receiving less than 5% of normal. Ephrata received even less, only recording a trace of precipitation on four separate July days (Table 2). The Olympic Peninsula into southwestern WA was also very dry, with precipitation ranging between 25 and 70% of normal. The Puget Sound area into the Cascades clocked in at greater amounts relative to average (90-200% of normal) mostly due the string of very wet days during the last full week of July.



Temperature (°F)



Precipitation (%)



July temperature (°F) departure from normal (top) and July precipitation % of normal (bottom). (High Plains Regional Climate Center (http://www.hprcc.unl.edu); relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	66.7	63.8	2.9	0.27	0.63	43
Seattle WFO	69.0	65.9	3.1	1.25	0.79	158
SeaTac AP	69.2	65.7	3.5	0.77	0.70	110
Quillayute	60.5	58.9	1.6	0.82	1.98	41
Hoquiam	61.3	59.9	1.4	0.83	1.14	73
Bellingham AP	65.4	62.3	3.1	1.13	1.18	96
Vancouver AP	71.1	68.4	2.7	0.82	0.69	119
Eastern Washington						
Spokane AP	75.7	69.8	5.9	0.18	0.64	28
Wenatchee	80.6	74.2	6.4	0.38	0.27	141
Omak	78.2	72.7	5.5	0.17	0.81	21
Pullman AP	70.5	65.6	4.9	0.33	0.69	48
Ephrata	80.0	74.2	5.8	T	0.40	0
Pasco AP	78.8	73.5	5.3	0.03	0.28	11
Hanford	82.8	77.1	5.7	0.04	0.23	17

Table 2: July climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in NCDC's new normal release, as records for these station began in 1998 and 1986, respectively.

Climate Outlook

The equatorial Pacific Ocean is still in the ENSO-neutral category, according to the Climate Prediction Center (CPC): http://www.cpc.ncep.noaa.gov/. Averaged over the last month, above normal sea-surface temperatures (SSTs) have actually decreased in the eastern equatorial Pacific. Despite the weakening, there is still a consensus among the model predictions that an El Niño will develop as early as this summer. The chances of the El Niño developing this summer remain at about 70% and the chances of the El Niño developing during the fall or winter is 80%. The "El Niño Watch" that was initially released by the CPC in early March is still in effect.

The Climate Prediction Center seasonal outlook for August is indicating increased chances of above normal temperatures statewide. For precipitation, there are equal chances ("EC") of below, equal to, or above normal precipitation statewide.

The three-month August-September-October (ASO) outlook is very similar to the August outlook. There are increased chances of warmer than normal temperatures throughout the entire state (exceeding at least a 40% chance for most of the state using the three-tiered outlook system). For precipitation, there are equal chances of below, equal to, or above normal precipitation.

August outlook for temperature (left) and precipitation (right) from the CPC.

August-September-October outlook for temperature (left) and precipitation (right) from the CPC.